

National Agricultural Research, Extension, Education and Economics Advisory Board

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Report on Climate Change and Agriculture September 23, 2009

EXECUTIVE SUMMARY

The National Agricultural Research, Extension, Education and Economics (NAREEE) Advisory Board met in April of 2009 to discuss the impacts of global climate change on agriculture and the food system. The following report is the result of discussions with national program leaders, a review of current United States Department of Agriculture (USDA) climate change activities and programs, and research conducted by the Work Group.

While the causes of climate change are widely debated, the NAREEE Advisory Board recognizes that regardless of the source, a shift in global temperature is occurring and action must be taken to address the resulting changes.

Many of the impacts of climate change must be evaluated in the context of the broad concerns about sustainability. The Board recommends action in three areas: adaptation strategies, mitigation approaches, and carbon-offset policies.

The Board came to the following conclusions:

- 1) Research on adaptation strategies should be expanded to ensure that components of the agricultural system are economically viable as the impacts of climate change are experienced. Consideration should be given to funding some research on a regional basis as well as the national level to ensure that the unique needs of various regions are addressed by research and outreach.
- 2) Research on mitigation strategies is needed to help the agricultural system identify potentially significant contributors to climate change and participate in the reduction of greenhouse gas emissions. The development and standardization of the carbon life cycle assessment for products of agricultural origin should be a priority.

- 3) The USDA should assume leadership in the development of methods for quantifying all variables associated with carbon off-set policies, with specific attention to carbon sequestration and analyzing the costs-benefits of these policies.
- 4) Quantitative models to predict the reductions in greenhouse gas emissions resulting from change in agricultural production, handling and distribution practices must be developed.

The USDA is well-equipped and should address many of the critical challenges associated with global climate change and the resulting impact on agriculture, natural resources, and the environment.

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Background

The National Agricultural Research, Extension, Education, and Economics (NAREEE) Advisory Board met in April of 2009 to discuss agriculture in relation to global climate change. A Work Group was appointed to identify, organize, and discuss key topics associated with climate change for addressing in a focus session. Presentations were provided by national program leaders from the Research, Education and Economics (REE) mission area and other experts knowledgeable about climate change. The Work Group also reviewed research activities associated with climate change occurring within the U.S. Department of Agriculture (USDA). This report is the result of a compilation of information and discussions surrounding the topic of agriculture as it relates to climate change.

The contents of this report are not intended to address the broad issues of climate change and the ultimate impacts on society. Rather, the report recognizes that trends in temperature, precipitation, and weather patterns are occurring and regional impacts on agricultural production will be experienced. The focus of the report is on changes needed to adapt to the trends and approaches to be considered to reduce the impact of agriculture on the trends.

The Board recommends action in three key areas: adaptation strategies, mitigation strategies, and carbon-offset policies.

Adaptation Strategies for Agriculture

Responses to climate change will depend on the benefits and costs of adaptation, local conditions and the immediacy of any potential impacts from localized changes in temperatures,

precipitation, and frequency and intensity of storm events. U.S. farmers could experience longer growing seasons, increased frequency of heavy rainfall, reduced snow pack with consequences for water supplies, enhanced crop growth due to elevated atmospheric CO₂, and increased frequency of droughts, pests, and crop and livestock heat stress according to McCarl and Rose (2008).

U.S. agricultural production has shown that it can successfully adapt to a broad range of climatic conditions, including those in irrigated, arid, dryland and humid areas. The various production areas are supported by substantial local research and technology diffusion efforts plus investment in appropriate technologies. Agricultural adaptation to climate change may involve shifts in management, changes in enterprise mix and adoption of new technology requiring direct capital investment and/or practice improvements developed through agricultural research.

Agricultural capacity to adapt in the future depends on public and private investments and developments which enable adjustment by farmers, and by the level and rate of local climate change. However, even with adaptation, individual farmers may still face less profitable production systems. Climate change may eventually dampen growth rates in crop yield and livestock productivity improvements. Research investments may need to be increasingly devoted to maintaining productivity, as well as increasing productivity. Investments and capital intensive agricultural practices may need to spread to new locations such as irrigation in areas where soil moisture is expected to decline due to increased temperature and or decreased rainfall. Processing facilities may need to relocate with migrating cropping patterns. Extension activities may need to be broadened to include educational outreach and dissemination of adaptation strategies.

The Department is presently leading efforts to develop and deploy adaptation strategies that minimize the effects of climate change. Climate change research databases and improved technologies are targeted to enhance the quality of policy decisions in response to climate change. The Agricultural Research Service is moving forward with several well grounded priorities. Crop variety research seeks those that are adapted to new growth conditions (temperature, water availability, atmospheric carbon dioxide levels), especially for regions of the world where climate change and food security risks coincide. Models predicting pest outbreaks combining data on crop growth and yield with pest biology and ecology seek to minimize the

spread and severity of outbreaks. Resource decisions about water delivery, distribution, and water use among competing demands require support systems that incorporate both remote and on-site data. Agricultural management strategies must emphasize systems that are economically competitive and environmentally sustainable. In addition, adaptation of cropping systems for a carbon economy raises important issues addressed later in this document. Since much of the impact of climate change will be regional within the U.S., it would seem appropriate to increase funding for adaptation research on a regional basis at land-grant universities and other universities with agricultural research programs as well as the national level. These types of research could be directed at unique cropping systems and livestock practices as needed for the production, distribution and processing systems in that region. The new information from these types of research would then be immediately available for dissemination by the extension and outreach system in that region.

There are opportunities for U.S. research to help agriculture adapt to climate change in ways that interact with the interest in energy production and the need to help assure food security throughout the world. This is especially important as some of the more populous developing countries in tropical regions are anticipated to be impacted more heavily by climate change than are more temperate zone countries. The traditional productivity-enhancing research long driven by the U.S. land grant universities, other universities with agricultural research programs, and the USDA needs to be adequately funded to not only maintain but increase U.S. agriculture's ability to meet the need for food, feed, fiber and fuel for an increasing and more affluent world population demanding improved nutrition and better diets. A substantial investment in adaptive research focused on those crop and livestock characteristics deemed most likely to be impacted by climate change will likely pay substantial dividends going forward.

Mitigation Strategies for Agriculture

The anticipated societal outcomes of climate change are driving the urgency of developing agricultural mitigation strategies that will soften the impact of this phenomenon and possibly generate economic growth for rural America. Several of USDA's agencies and services are involved in studying climate change and its implications. Their studies, however, seem to focus primarily on theoretical mitigation approaches that lack clear, concise and sustainable plans. The Department's agencies must be encouraged to move quickly and decisively with their

recommendations as the quest for guidance -- nationally and globally -- is present, giving agriculture the opportunity to lead.

All segments of agriculture must understand the need for examining strategies and evaluating changes that would reduce the effects of climate change. USDA recognizes the need for research into farming systems, including the complete food and agricultural products supply chain, to evaluate the carbon life cycle assessment of producing energy from agricultural sources and the associated impacts. It should also be noted that life cycle assessment is more than producing energy from agricultural sources; indeed, it is the amount of carbon-based energy and materials consumed in producing, transporting, and marketing agricultural goods and products. The development and standardization of the life cycle assessment process to be used for all products of agricultural origin should be a priority for the Department. These steps will demonstrate the willingness of the agriculture sector in contributing to mitigation of climate change, and ensure that the products from agriculture are compared to products from other origins in an equitable manner. USDA agencies must look at opportunities to collaborate with those universities and industries actively engaged in this activity to promote standardization and thus comparability throughout the industry. It is from this type of research that the Department can help producers identify multifaceted, science-based strategies to either reduce emissions or sequester carbon that will be economically and environmentally sustainable. Currently, the science of minimizing climate change impacts seems to have garnered greater attention than the economics of adopting the science. Producers need accessible and basic information available for their use, outlining the economic consequences of climate change and the science behind the recommendations before they will adopt them.

While the science seems to indicate that carbon sequestration is a good opportunity for agriculture, the methods of accomplishing sequestration need to be quantified along with the cost/benefit equation. The reduction of greenhouse gas emissions through the use of manure digesters is an example of clarifying the economic impacts to the farm operators prior to adoption. Knowledge of the current research and potential financial opportunities is not widespread throughout the agricultural production community. The Cooperative Extension Service can be the catalyst to develop and communicate such information.

Finally, all mitigation strategies must be understood in the political arena. Agriculture must be viewed as a significant player in resolving the climate change issues rather than merely a marginal contributor. The USDA agencies have the opportunity to shape the mitigation strategies that will be economically and environmentally sustainable to all stakeholders along the food supply chain -- if the priority for research remains in the forefront.

Carbon-Offset Policy Research

Carbon offset policies introduce a unique array of questions for agricultural enterprises and the agricultural sector. These questions include the potential economic implications of options for participation of the agriculture sector in carbon offset markets. Due to the voluntary nature of these markets, the extent of participation from the agriculture sector will depend on the quantitative details of the policies and the economic efficiency and environmental performance of the offset market. Research on development of quantitative models to predict the reductions in greenhouse gas emissions to be achieved by changes in agricultural practices and activities is needed. These models should address the economic impacts of changes in activities and practices on the extent of emission reductions and/or improvement in sequestration. Research is needed to support carbon offset policy design, including quantification of transaction costs, and the potential interactions among various practices and activities.

Although the carbon offset market mitigation approach for the reduction of greenhouse gas emissions would be directed at large-scale industrial contributors of the gases, the opportunities for the agricultural sector to participate in the markets to be created will depend on quantification of emissions from agricultural enterprises, as well as the sequestration capabilities of various components within the agricultural sector. Since these challenges are unique to agriculture, it seems critical for USDA to assume leadership in conducting the research needed to ensure equitable participation in the carbon offset markets.

The contributions of agriculture to greenhouse gas emission and carbon sequestration are a function of many agricultural practices and activities. Changes in these practices can reduce emissions and increase sequestration. For these practices to be embraced for participation in carbon offset markets, the emission/sequestration levels must be quantified in a manner that is equitable, reproducible and scientific. Even the units for expressing the levels of contribution

may need to be confirmed. There are five distinct issues to be addressed in carbon offset market research:

1. Baseline – the establishment of a quantitative baseline for each practice or activity must be established. This baseline is critical so that reduction in emissions or increases in sequestration can be measured.
2. Additionality – the contribution of a change in an agricultural activity or practice beyond the baseline must be quantified. This issue would deal with identification of practices that are eligible for participation in an offset program.
3. Leakage – the indirect impacts of a change in an agricultural practice or activity must be quantified. These negative impacts would include unintended reductions in production or increased cost of production.
4. Uncertainty – the uncontrollable factors that affect a change in agricultural activity or practice must be quantified. Factors, such as weather, will influence the actual contribution of a change. Models for accurate prediction of impacts would be important.
5. Permanence – the permanency or longevity of the impact of a change in activity or practice must be quantifiable. While certain sectors of agriculture, such as forestry, may be easy to quantify, other less-permanent changes may be more difficult.

All of these issues require careful attention from various research disciplines within USDA or its funded programs outside the agency such as through the land grant universities and other universities with agricultural research programs. Some of the specific objectives to be addressed include:

- Ensure that carbon offset outcomes from the changes in agricultural practices and activities are expressed in a manner consistent with outcomes from other industrial sectors.
- Provide adequate models for prediction of carbon offset outcomes from changes in agricultural practices and activities.

- Explore the economic impact of changes in agricultural practices and activities, with specific attention to the incentives for the agricultural sector to participate in carbon offset markets and for the markets to incorporate agricultural offsets.

The successful accomplishment of the research in response to these objectives would ensure active participation of agricultural enterprises and practices in carbon offset markets. The proposed objectives may be achieved by expanding current research within USDA agencies and through their programs with partners.

Conclusion

It seems imperative that strategies for adaptation to and mitigation for climate change be developed for the agricultural system. The USDA should be encouraged to continue current research activities on adaptation to climate change and expand as needed to ensure that agricultural producers have the capabilities to remain economically viable. Research on mitigation is needed for all components of the agricultural system to identify opportunities for agriculture to participate in the overall reduction of greenhouse gases emissions. A standardized life-cycle analysis system should be developed to ensure that products of agricultural origin are competitive when evaluated in the context of sustainability. More aggressive mitigation approaches, such as carbon offset policies, need to be evaluated to ensure that the entire agricultural sector participates in a positive manner.

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